

CLAIMS

What is claimed is:

1 1. In a voice communication system, wherein transmission of voice information
2 through an interface is represented by successive data frames respectively contained in a
3 succession of pitch synchronous frames, and at least one of the data frames is subject to being
4 lost, a method for improving quality of the voice information at a receiving side of the system,
5 the method comprising the steps of:

6 detecting the loss of a particular data frame at said receiving side; and

7 replacing the particular pitch synchronous frame containing said lost data frame
8 with a replica of the pitch synchronous frame immediately preceding said particular pitch
9 synchronous frame in said succession.

1 2. The method of Claim 1 wherein said detecting step comprises:
2 detecting a loss of signal energy associated with said particular pitch synchronous
3 frame.

1 3. The method of Claim 1 wherein said detecting step comprises:
2 computing a threshold value associated with said particular pitch synchronous
3 frame; and
4 selectively comparing an average magnitude of said particular pitch synchronous
5 frame with said threshold value.

1 4. The method of Claim 3 wherein:
2 a difference value is computed by subtracting said average magnitude of said
3 particular pitch synchronous frame from an average magnitude associated with said immediately
4 preceding pitch synchronous frame, loss of said particular pitch synchronous frame being
5 indicated if said difference value exceeds said threshold value.

1 5. The method of Claim 1 wherein:
2 said method includes the step of estimating a threshold based pitch synchronous
3 period associated with said transmitted voice information.

1 6. The method of Claim 5 wherein said estimating step comprises:
2 generating a train of signal samples from said voice information, said samples
3 collectively representing a succession of signal waveforms;
4 identifying respective positive peaks of said waveforms; and
5 computing the period between two consecutive peaks to provide said pitch synchronous
6 period estimate.

1 7. The method of Claim 6 wherein:
2 said communication system comprises a Bluetooth voice transmission system.

1 8. The method of Claim 1 wherein:
2 said system is disposed to mute transmitted data frames affected by interference in
3 said transmission interface.

1 9. A method for transmitting voice information through an air interface comprising
2 the steps of:

3 transmitting a succession of data frames of signal samples collectively
4 representing said information into said interface, from a transmission side thereof, said data
5 frames respectively contained in a succession of pitch synchronous frames;

6 muting a data frame which becomes lost in said interface;

7 receiving said succession of pitch synchronous frames, including a particular
8 pitch synchronous frame containing said muted data frame, at a receiving side of said interface;

9 detecting said muted data frame in said particular pitch synchronous frame at said
10 receiving side; and

11 replacing said particular pitch synchronous frame with a replica of the frame
12 immediately preceding said particular pitch synchronous frame in said pitch synchronous
13 succession.

1 10. The method of Claim 9 wherein said detecting step comprises:

2 computing a threshold value associated with said particular pitch synchronous
3 frame; and

4 selectively comparing an average magnitude of said particular pitch synchronous
5 frame with said threshold value.

1 11. The method of Claim 10 wherein:

2 a difference value is computed by subtracting said average magnitude of said
3 particular pitch synchronous frame from an average magnitude associated with said immediately
4 preceding frame, loss of said muted data frame being indicated if said difference value exceeds
5 said threshold value.

1 12. The method of Claim 11 wherein:

2 said method includes the step of estimating a pitch period associated with said
3 transmitted voice information.

1 13. In a voice communication system, wherein transmission of voice information
2 through an interface is represented by data frames respectively contained in a succession of pitch
3 synchronous frames and at least one of the data frames is subject to being lost, apparatus for
4 improving quality of the voice information at a receiving side of the system comprising:

5 a lost frame detector for detecting the loss of a data frame at said receiving side;

6 and

7 an error concealment device for replacing the particular pitch synchronous frame
8 containing the lost data frame with a replica of the pitch synchronous frame immediately
9 preceding said particular pitch synchronous frame in said succession.

1 14. The apparatus of Claim 13 wherein said lost frame detector is disposed to detect a
2 loss of signal energy associated with said particular pitch synchronous frame.

1 15. The apparatus of Claim 13 wherein:

2 said detector is disposed to compute a threshold value associated with said
3 particular pitch synchronous frame and to selectively compare an average magnitude of said
4 particular pitch synchronous frame with said threshold value.

1 16. The apparatus of Claim 15 wherein:

2 said lost frame detector computes a difference value by subtracting said average
3 magnitude of said particular pitch synchronous frame from an average magnitude associated with
4 said immediately preceding frame, loss of the data frame in said particular pitch synchronous
5 frame being indicated if said difference value exceeds said threshold value.

1 17. The apparatus of Claim 13 wherein:

2 said apparatus includes a device for estimating a pitch period associated with said
3 transmitted voice information.

1 18. The apparatus of Claim 17 wherein said pitch estimating device is disposed to:

2 generate a train of signal samples from said voice information, said samples
3 collectively representing a succession of signal waveforms;
4 identify respective positive peaks of said waveforms; and
5 compute the period between two consecutive peaks to provide said pitch period
6 estimate.

1 19. The apparatus of Claim 13 wherein:

2 said communication system comprises a Bluetooth voice transmission system.

- 1 20. The apparatus of Claim 13 wherein:
- 2 said system is disposed to mute transmitted data frames affected by interference in
- 3 said transmission interface.